# Notes on Vertical test results of cavity TE1ACC002-04

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### Current test summary

Cavity TE1ACC002 has been tested for the fourth time.

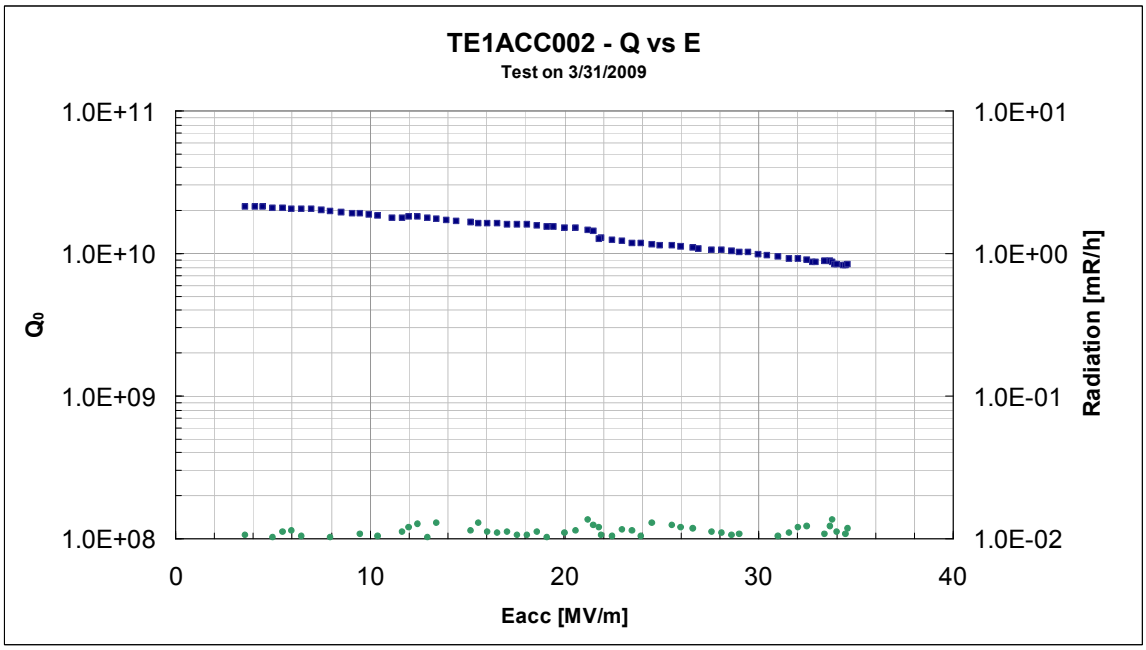


Figure 1: Q and radiation versus Eacc for TE1ACC002 test #4.

During the fourth test on 3/31/2009, cavity was paired to another cavity and cooled down to 2K with active pumping. CW power measurement was performed without the Q-T measurement. Low field $Q_0$ was $2.13 \times 10^{10}$. Dewar pressure gradually increased unnoticed until 11 MV/m which resulted cavity temperature rising above 2.02K and its effect visible on Q-Eacc curve shown in Figure 1. After pressure dropped to normal operating pressure, the test continued until 21.8 MV/m. Quench incident repeated more than five times. While neither electron activity nor X-ray was observed, it is believed the quench was caused by equator region multipacting since the Tesla shape cavity was known to have highest probability of multipacting at 21 MV/m. The multipacting processing was as short as 3 minutes. The quench certainly caused the drop of cavity Q after 21.8 MV/m and was non-recoverable. Once the cavity reached at 33 MV/m, quench became persistent. Yet the cavity was able to overcome the initial limit and achieved 34.6 MV/m. This is comparable to the previous achieved 37.1 MV/m giving the 10% measurement error of highest Eacc. Beyond 34.6 MV/m, the quench became harder to overcome. Full body diode T-map showed a hot location below equator and immediate followed by large area of lower half of the cavity becoming hot. Another interesting phenomenon was the quench relaxation time. Initial quench

was consistently followed by two lower field quench. This may suggest the cavity temperature did not fully recover right after the first quench. Previous T-map experiments at Cornell University and Jefferson LAB indicated the thermometers do not reduce the cavity cooling in the event of quench. While the T-map data is still being analyzed, it was very unusual for a quenched cavity being able to overcome its limit in absence of clear indication of electron activity.

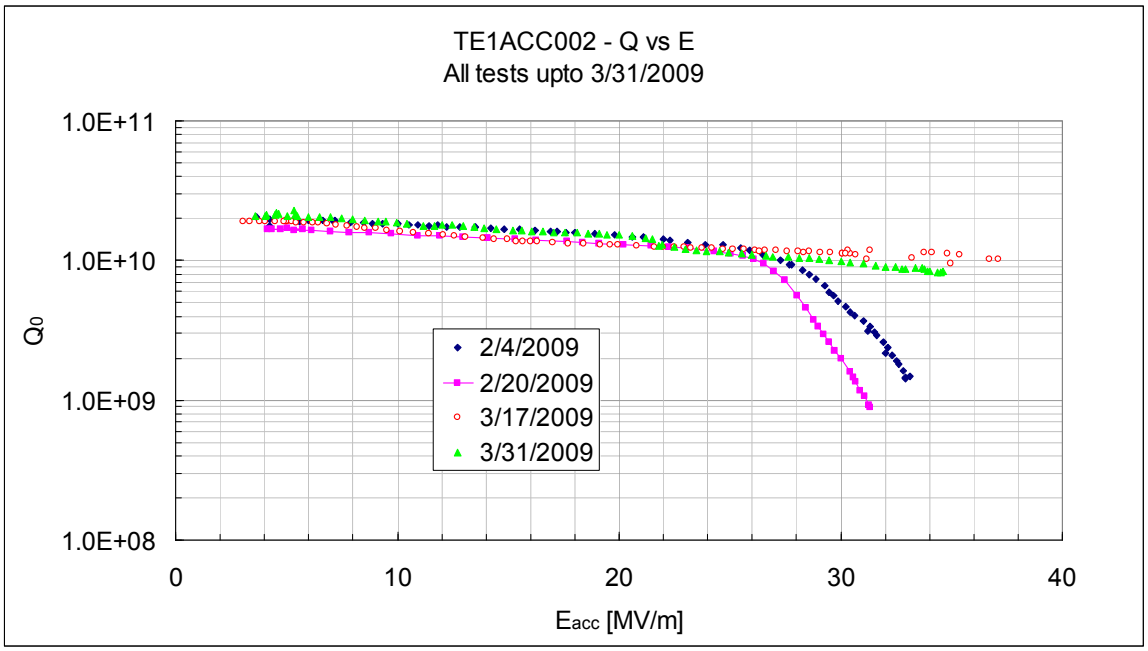

Figure 2: Overall Q versus Eacc for TE1ACC002 tests.

**Previous RF tests**

After the cavity was received from ACCEL, it was inspected using camera inspection system developed by KEK and Kyoto University. No significant feature was observed, indicating a high quality manufacturing. Cavity was electropolished at ANL with a bulk material removal of 112 μm. (http://tdserver1.fnal.gov/genfa/single/images/TE1ACC002/index.html)

First test was done on 2/4/2009. Performance was at 33.1 MV/m limited by power due to strong q-slope (started around 24 MV/m) and Field emission loading (starting at 21.5 MV/m, peaked at 3 mR/h, when 33.1 MV/m). It was worth noting the cavity was pumped by a newly installed vacuum pump station. (http://tdserver1.fnal.gov/genfa/single/TeslaSingle/TE1ACC002/TE1ACC002TestNote.pdf)

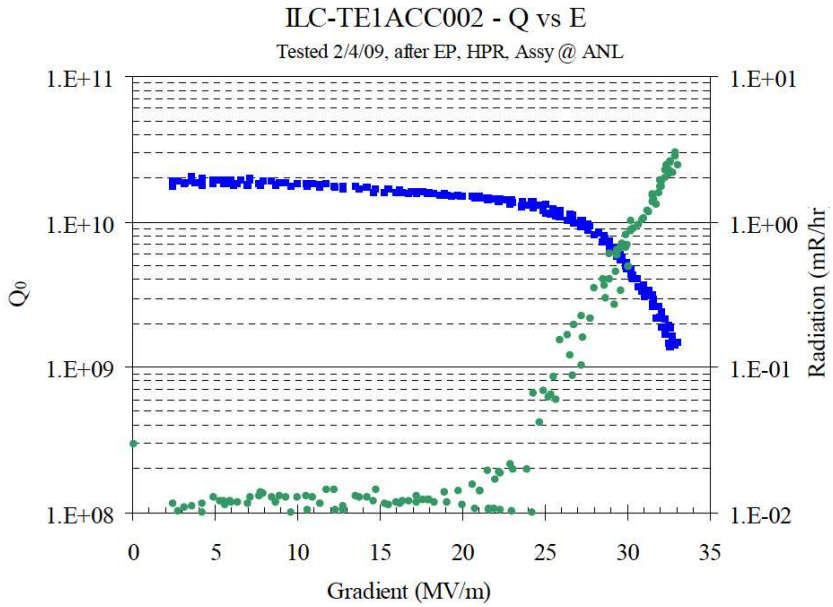

Figure 3: Q and radiation versus Eacc for TE1ACC002 test #1.

Second test was done on 2/20/2009, after the cavity was rinsed by high purity particle free ethanol (10 minutes) followed by high pressure water rinsing. Performance was at 31.3 MV/m limited by power solely due to strong q-slope. No electron activity was observed. No above background X-ray was detected throughout the test.
(http://tdserver1.fnal.gov/genfa/single/TeslaSingle/TE1ACC002/TE1ACC002-2TestNote.pdf)

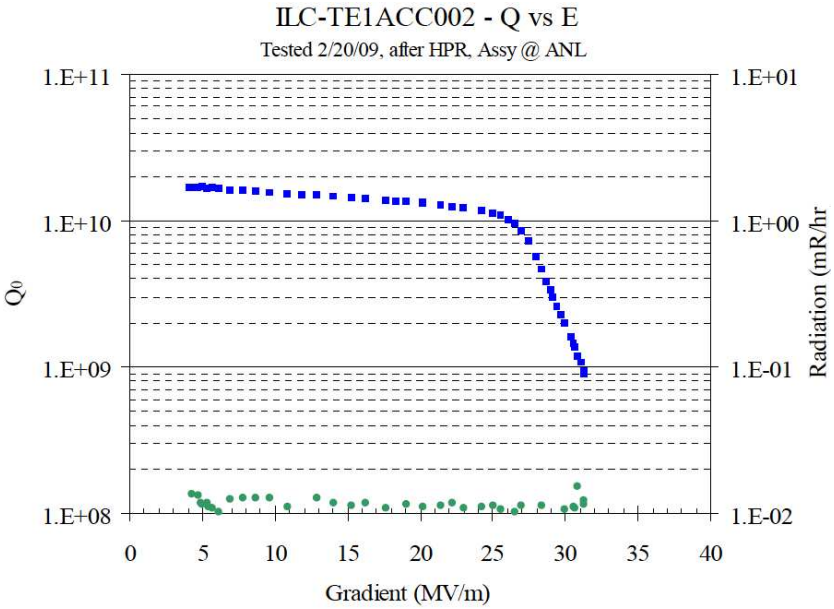

Figure 4: Q and radiation versus Eacc for TE1ACC002 test #2.

Third test was done on 03/17/2009 as part of the two-cell test trial. The cavity was baked at 120 C for 48 hours and was fitted with fast thermometry system before cool down. Cavity performance was limited by quench around 37.1 MV/m with q-slope eliminated. Fast thermometry identified the likely quench location within 45 degree azimuthally. For field above 30 MV/m, the RF signal exhibited some instability due to the cable connector. Again, no significant x-ray was observed through the test. Both the cable connector problem and the coarse quench location, it was decided to test the cavity again with better RF connector and full body diode T-map.
(http://tdserver1.fnal.gov/genfa/single/TeslaSingle/TE1ACC002/TE1ACC002-3TestNote.pdf)

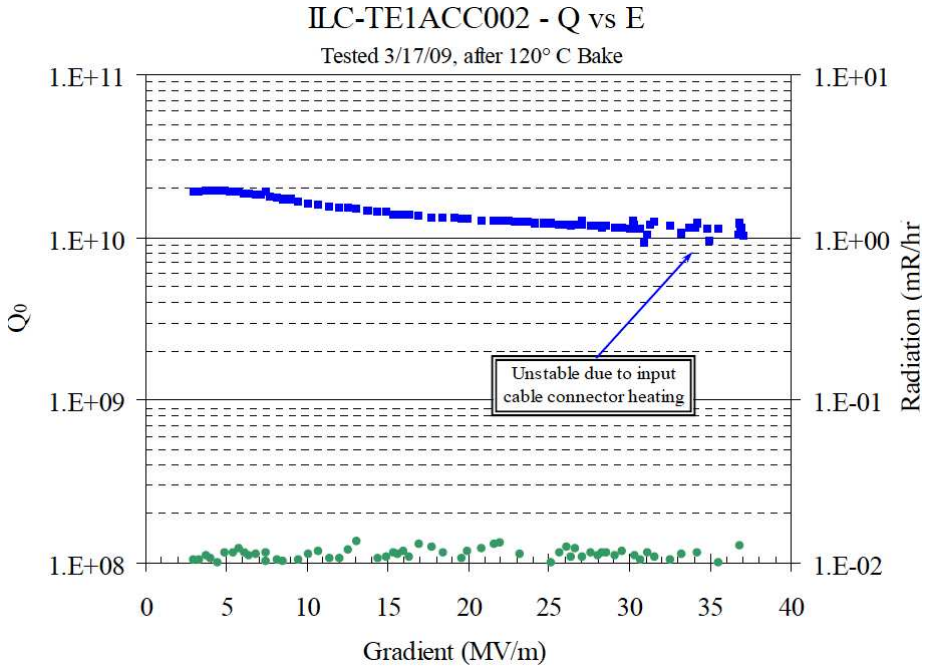


Figure 5: Q and radiation versus Eacc for TE1ACC002 test #3.

Note: this note will be updated after T-map data and post EP surface inspection.